TRUSS-BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS-BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

By F. B. Brock, Patent Attorney, Washington, D. C.

Price and Phillips, by Letters Patent, bearing date Feb. 23, 1841, constructed a bridge which they styled a "Puzzle Keyed Bridge," from the fact of its being similar in its joining to the binding together of the toy, sometimes called a "puzzle knot." The improvement consists in the employment of the last pieces of timber inserted in the truss frame in such a way as to cause them to operate as keys, and to bind the whole frame together without the use of trenails, bolts, wedges, etc.

FIG. 5.

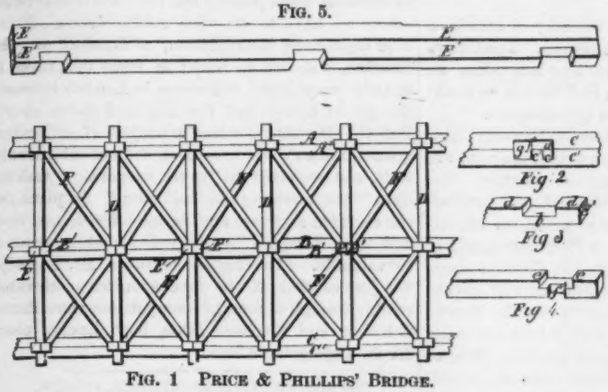
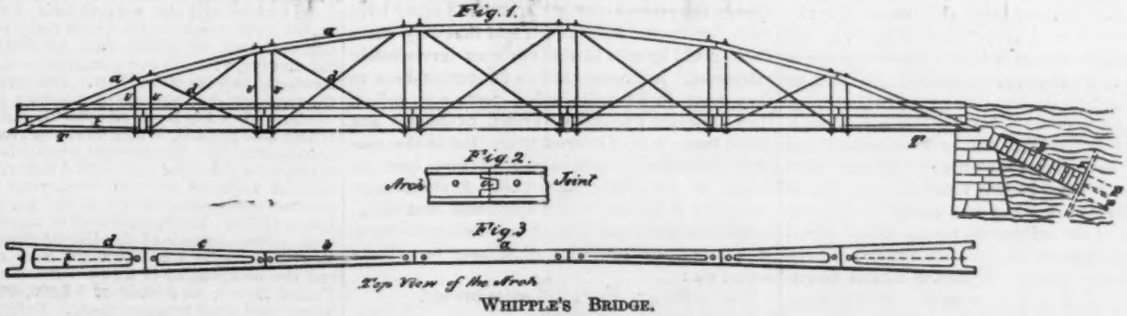


FIG. 1 PRICE & PHILLIPS' BRIDGE.

Fig. 1 is a view of a part of a truss frame, and Figs. 2, 3, 4, and 5 details of the same. *A A* are two upper chords, *B B* two similar chords which sustain the floor timbers and *C, C* the lower string pieces or chords; *D D* are vertical posts which are double like the chords, and embrace the chords between them; *E E* are the ends of the cross-ties embraced between the string pieces, and forming also the keys by which the trusses are bound together; *F F* are the ordinary cross braces.

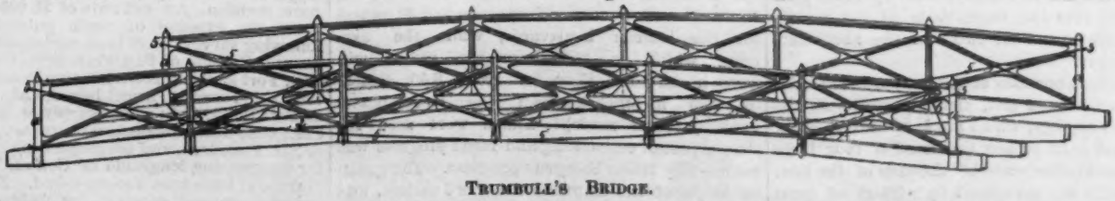
Fig. 2 shows one of the combined chords *C C*, with a front view of the notches which are to admit the cross-ties. The first cross-tie occupies the end *a*, and it is to be notched out as shown in Fig. 3. The edge *b* is placed so as to occupy the recess *c* in the chord *C*, and so that the face *d d* of the cross-tie may be in range with the dotted line *f*. The piece *C* of the lower chord serves to retain the first cross-tie in place. The length of the notch in Fig. 3 is equal to the width of the double upright posts. These posts are to be notched out at each joining of them, with the respective chords and the cross-ties, in the manner shown in Fig. 4, the chords being embraced between the ends of the notch *cc*; and the notch *f* in each of the posts coinciding with the opening *g*, which is to receive the second cross-tie by which the whole is keyed together. The second cross-ties may be made somewhat wedge-formed, as shown at *E*, Fig. 5, where a pair of cross-ties are represented. When inserted, the effect is to strain up the first string piece, and truss the whole of the frame work together. The inventors say their invention can be applied to arch bridges.

April 24, 1841, Squire Whipple, of New York, received a patent for an iron truss-bridge, which possesses some features in use in the bridges of to-day. This patent was extended seven years from April 24, 1855. The construction embodies two or more trusses of iron. Each truss consists of an arch *a* of cast iron, extending the whole length of the span. One or more trust-ties *T T* extend along or through or near to the chord of the arch, and connected with the extremities thereof. To sustain the thrust and prevent the spreading of the arch vertical rods *v v* of wrought iron are used, which serve both as ties and posts between the arch above and the floor and thrust-ties below. Diagonal ties *d d* of wrought iron or braces of cast iron, in pairs, cross one another between the vertical rods and between the arch and the thrust ties *t*, except under the segments of the arch where only one tie is used. The arch is formed in segments of from 10 to 20 ft., and is made of angle iron, the flanges depending. The arch is narrowest in the middle and diverges toward either end, which counteracts lateral flexure. The joints of the arch are furnished with extensions and depressions, as seen in Fig. 2. To give the diagonal ties a more uniform obliquity, the segments may be made shorter towards the ends of the arch. One thrust tie is under each side of the arch. The abutments may be strengthened by a slope wall *s*, or frame work of timber on the back side extending into the earth so as to form nearly a continuation of the arch of the truss.



WHIPPLE'S BRIDGE.

July 10, 1841, Earl Trumbull, of New York, invented an improved mode of constructing bridges. The engraving represents an isometrical perspective of the trusses, each composed of wrought-iron tie rods and suspension rods extending from end to end. The sills extend from a post in one truss to the opposite post in the other truss. The cross braces are of wrought iron and serve to strengthen the roadway and prevent any lateral motion of the bridge. What the inventor terms suspension rods are represented by the Figs. 5 5, etc. They are of wrought iron, and spring from a point near the top of the end posts *a a*. It will be



TRUMBULL'S BRIDGE.

* Copyright, 1882.

observed that these rods form a suspension curve. These rods pass at the apex under the center sill, and support the truss at the points either by passing under projections cast for the purpose to the posts or by passing through holes in projections on the sills. The suspension rods are placed on both sides of the truss. The tie rods extend the whole length of the bridge, passing over the projections at the ends of the sills, being confined to their places at these points by small notches cast to receive them.

(TO BE CONTINUED.)

THE VIADUCT OF THE VAL SAINT LÉGER, ON THE PARIS BELT RAILWAY.

[Translated from *L'Illustration*.]

The magnificent viaduct of the Val Saint Léger, near Saint Germain, on the great circular railroad of Paris, near Mariel Marly, must be considered as one of the finest specimens of engineering art.

There were considerable difficulties in the way of construction, owing to the loose nature of the soil on which it is built, still, despite these and the importance of the work in itself, the cost did not exceed 1,251,000 francs.

The viaduct has certain peculiarities of construction that will be interesting to our readers, and an explanation of which will redound to the credit of the two eminent engineers who constructed it, M. Armand, head engineer, director of the railway in question, and who has directed some 700 kilometers of railways, and especially the Algerian network of roads, and M. Ch. Geoffroy. Besides these must be mentioned M. Berton, sub-engineer, M. Regnier, and the contractors, Messrs. Hersent & Roussel.

The viaduct is built over a valley in which the geological conditions were most unfavorable, and the engineers were delayed a long time in making the survey for the line. Several places were selected and had to be again abandoned, and it was only after careful study that the solution now carried into execution was adopted.

The numerous soundings made showed that the sides of the valley were formed of calcareous banks, more or less disjointed and resting on a deep layer of clayey and very watery sands, below which was a thick bank of plastic clay. This last rested on the chalk, which may be observed cropping up at Marly, and which is only met with where the viaduct is built at a depth of from 25 to 32 meters.

As the calcareous strata did not exist in the lower part of the valley the foundations had to be laid on this chalk, and for the first time at such a depth.

The various systems of laying foundations, such as timbered shafts, piles, etc., were examined and laid aside, as was also a plan with metallic arch which would have looked very fine, but which could not be considered as sufficiently solid, owing to the slips of the calcareous layers which would certainly take place. It was then decided to have a straight-beam metallic viaduct of a total length of 311 meters (337 yards), so as to rest the abutments supporting the ends of the iron framing on the calcareous sides of the summits and sides of the valleys and of the thalweg. Wherever these banks were much inclined, disconnected or altogether absent, it was necessary to support the frame work by three piles which were sunk to the chalk by iron caissons, such as are used in pneumatic foundations. The work was then composed of two abutments in masonry of a length of 53 meters, formed of arches of 8 meters span and a metallic part 258 meters in length, supported by three piles and divided into four bays, those in the middle being 70 meters and the two near the abutments only 56 meters.

The apparent portions of the masonry is in tufa, which, from its red tint, contrasts well with the corners and copings, which are in white cut stone.

The metal part proper is formed of four large beams placed under each of the rails of the line. These beams are connected by girders of great lightness and with a platform in corbelling. The frame-work weighs only 5,000 kilos per linear meter, although for such heights this limit is often exceeded.

The middle pile has only an apparent height of 20 meters, but it measures 45 meters from the foundation. The frame-work required only 10 men to make it advance in sections of 100 meters over the rollers, and at a rate of 30 meters 60 cent. per hour.

ENGINEERS AND ENGINEERING IN FOREIGN LANDS.

The future of engineering projects promises well, as there is hardly any other field left for the absorption of capital. The French, Belgian and German iron markets are firm, and the new St. Gotthard line opening up the Italian markets for German coal.

Among the latest things in the way of canals is a plan to unite Cologne and Antwerp. The Chamber of Commerce of the former city has taken up the question enthusiastically, and there is no doubt of the support of the Prussian Government.

The next working campaign on the Panama Canal will open in December, and great preparations are making to have it as productive as possible. The Culebra mass is to be soon attacked, and preliminary surveys have already been made on the Atlantic side, at Lower Obispo, at Emperador, and at the culminating point where the Culebra shops have been put up. Working stations will also be opened at Gorgona, and at Paraiso, on the Pacific slope. To the greater facility of taking away the rubbish, a railroad will be built between Chagres and Emperador. Of the material ordered, including 28 excavators, only four are yet in use, and 22 locomotives are shortly expected to arrive. The dredging material comprises four dredging engines, with spout of 60 horse-power, but only one is yet in use. Steam derricks, etc., are being sent, and altogether matters are taking a business look.

Most newspaper readers will recollect the catastrophe that the City of Szegedin—the second city in Hungary—met with a few years ago (1879), when, owing to the overpowering rise of the Theiss, the greater part of the city and many lives were destroyed. It was even said that only three ducks could be seen in the environs immediately afterward. As freshets are as dangerous here as they were in Szegedin a few years ago, and as they have lately been in Verona, of Romeo and Juliet fame, it is of interest to see that in the case of the former city, various methods have been resorted to for future protection. A commission composed of engineers and specialists was designated, and the works already executed, or in course of construction comprise what may be called a series, viz:

The building of quays and enrockments.

The canalization of the city.

Elevation of the city level.

Regulation of the course of the river, and finally the building of a bridge, etc. The cost of the quays is estimated at 1,500,000 florins. But, despite the elaborate system of double quay with enrockment, the engineers came to the conclusion that the best method for protecting the city against inundations was to rise the general level. This was only 5.07 meters above zero, while the waters of the Theiss have reached as high as 8.52 meters. Embankments were therefore made to 8.50 meters for the interior boulevards, while the avenues, which in this case are radial will have a uniform slope of from 8.50 meters to 6.70 meters between the two boulevards (circular roads). Trains were used for the purpose of embanking and rapid progress was made—fifty trains being run per diem. The greatest height of the embankment was 3 meters, and some one million cubic meter of earth will be required. The system of dikes on the right bank, with circular dike round the city, will be completed by a plantation of 40 hectares and by an extensive enrockment. The dikes on the left bank will necessitate a displacement of 5,000,000 cubic meters, and the talus on the water side will be furnished for a distance of three kilometers with a brick facing. Several sinuosities of the water course will also be cut. Numerous other works of great importance are under consideration—such as the regulation of the Danube between Vienna and the Hungarian frontier, and a canal from the Danube to the Oder.

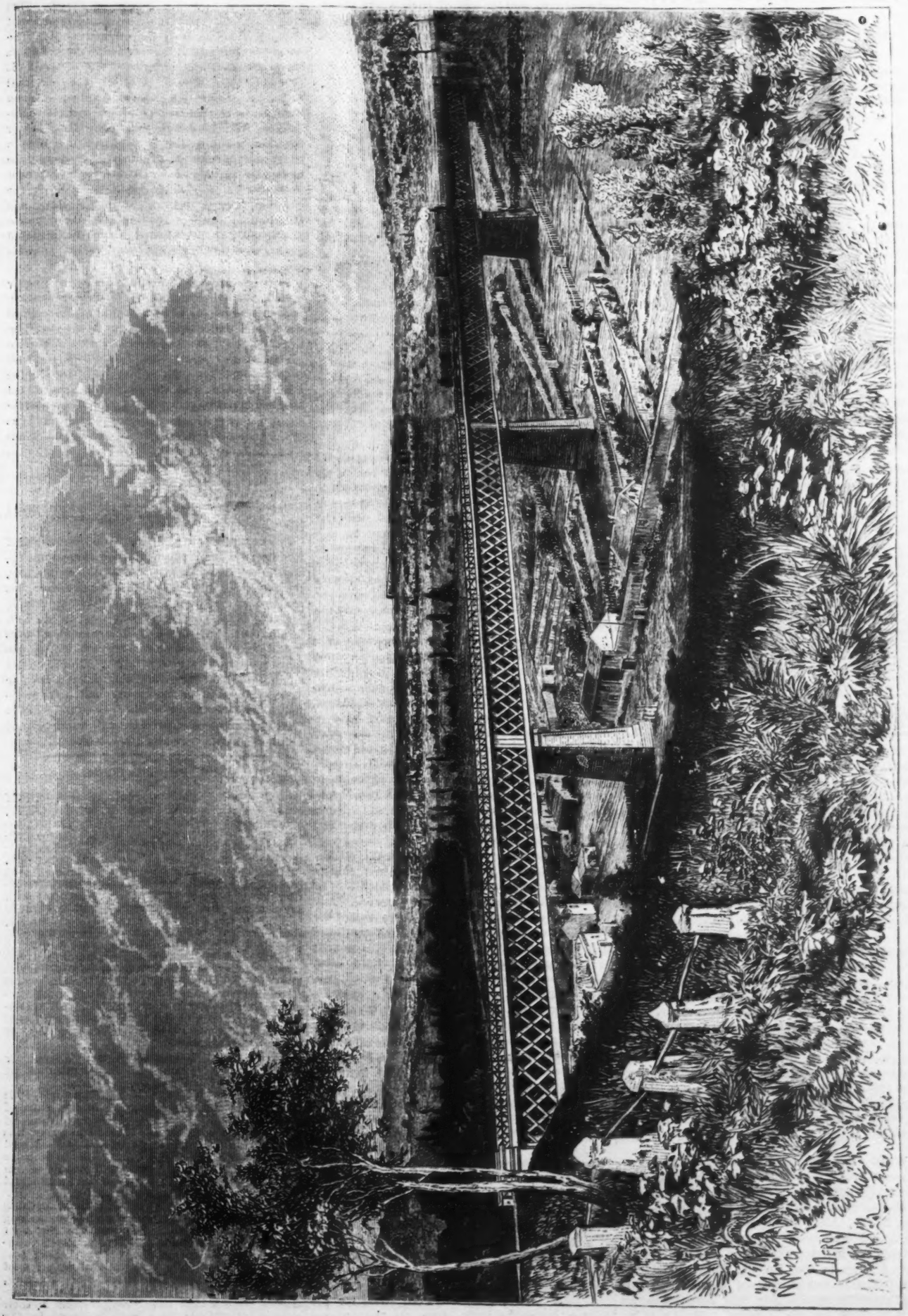
Elevated railways would seem to offer a greater field to contractors and engineers than was at first supposed. The elevated roads have been roundly abused, and certainly they are not to be compared to those on *terra firma;* but the case is otherwise when we have to do with subterranean. However highly the Metropolitan, of London, may be extolled, it should be borne in mind that there is usually very little difference in London between the gloom below and the fog and gloom above. But the Parisians, when a project of an underground railway was broached, did not take kindly to it, and preferred to travel suspension fashion than "down among the dead men." So plans for the elevated style are still being offered, and now and then accepted by large cities where space is so valuable. An English engineer, Mr. Fogerty, has just carried off the concession for an elevated road, although among his competitors were Baron Schwarz and Engineer Bode, both having plans for an underground line.

WORK OF THE ENGINEER CORPS.

ANNUAL REPORT OF GEN. WRIGHT, CHIEF OF ENGINEERS.

WASHINGTON, Nov. 14.—Gen. Wright, Chief of Engineers, in his annual report makes an estimate of $55.000 for engineering, maintenance, repairs, and construction of the Washington Acqueduct. The estimates for the care of public buildings and grounds in the District of Columbia amount to $232,000. General Wright says that an appropriation of $150,000 should be made for examination and surveys and contingencies for river and harbor improvements, for which there is no special appropriation, of which sum $50,000 should be for surveys, $100,000 for contingencies, including incidental repairs of harbors. The preparation of the final report on surveys of Northern and Northwestern lakes has been completed, and it is now nearly half printed. Water level observations have been continued. The amount available for these surveys for the fiscal year 1882–3 is $12,000. The amount required for the fiscal year 1883–4 for printing and issuing charts for the use of navigators is $3,000. The compilation of the new outline map of the territory of the United States west of Mississippi, scale 1-2,000,000 has been completed, and the compilation of a new outline map of the United States, on a scale of 1-5,000,000, has been begun and some progress made. Referring to the geographical surveys west of the one hundredth meridian, Gen. Wright reports that no field-work was done during the year, as there were no funds available for that purpose, and that the duties of the office have been confined to the reduction and computations necessary for putting unfinished map material in shape for publication and to the distribution of published maps and reports. He says that the amount originally appropriated for closing the work will not allow the publication of sufficiently large editions of the unissued map, nor furnish reissues of those maps now out of print and which have undergone revision. An estimate of $5,000 is made to cover the expense of such publication. The following surveys have been accomplished: Target range, Presidio of San Francisco, Cal.; reservation, Fort Halleck, Nav.; locating Presidio observatory rifle range at Angel Island, Cal.; rifle range at Fort Point, Cal.; water supply at Angel Island, Cal.; time determinators, with transit, at Presidio of San Francisco, and telegraphic signal exchange for determining longitude of Colfax, Washington Territory, have been accomplished. The estimate for the amount required for military surveys, reconnoisances and surveys of military reservations by the engineer officers, attached to the various head-quarters of military divisions and departments is $50,000, being an average of $5,000 for each of the nine military divisions and departments west of the Mississippi, and $5,000 for publication of maps.

NEW ELECTRIC COMPANY.—Articles of incorporation have been filed with the County Clerk, this County, of the Faure Electric Storage and Light Company. Capital, $2,000,000.



THE VIADUCT OF THE VAL SAINT LÉGER, ON THE PARIS BELT RAILWAY.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR.....ASSOCIATE EDITOR.

SATURDAY, NOVEMBER 18, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

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"SOME BIG THINGS."—In our last issue we published an article clipped from the New York *Sun* under the heading, "Some Big Things," which contained a brief description of the Kinzua viaduct on the Erie railroad extension, and gave the name of the Keystone Bridge Company as builders. The bridge in question was built by Clarke, Reeves & Co., Phœnixville Bridge Works, Phœnixville, Pa. We regret the error, especially as the bridge has attracted much attention, and as we always believe in rightly accrediting the successful accomplishing of a difficult work.

SUBSCALES INCLUDING VERNIERS is the title of a little pamphlet by Henry H. Ludlow, U. S. A., which presents a more thorough discussion of verniers than those in the ordinary text-books and in a very methodical and scientific manner. The word subscale refers to any auxillary scale of equal parts, of which the vernier is a special case. A complex subscale is illustrated which will enable one to measure hundredths of an inch on a common rule divided to quarter inches. It is shown that in all measurements for the accurate measurement of angles, no form of subscale can surpass the vernier.

WHEN "The History and Statistics of American Water-Works" is published as a book of some 1,000 pages next year, we suppose that the officers of the water-works of Reading, Pa., Wheeling, W. Va., Mobile, Ala., Davenport, Ia., San Antonio, Tex., and Springfield, Ill., will feel deeply aggrieved and indignant that they alone of the 100 largest cities in the United States should be omitted and their works not described. But if that should be the case they will have themselves only to thank for the omission. Mr. Croes has written to each of them four or more times, begging them to send the data of their works and enclosing blanks. Not a reply has been received, and without the information, of course no description can be prepared.

STRESS AND STRAIN.

In exact science it is necessary to have a great number of technical or special terms, which are always to be used in accordance with prescribed definitions. The boy finds in the first pages of his geometry long explanations or definitions attached to simple words like line, plane and circle, or rather he finds that these words have been selected to represent certain precise ideas. Previously he used the word plane with more or less vagueness; now he uses it with a clear idea of how it may be distinguished from other surfaces. So also with such a term as center-of-gravity. When employed in popular language its meaning is usually something like middle point; when technically defined the problem is half solved how to find and locate it.

When the words stress and strain are used in common language their meaning is more or less clear to everyone. Strain is a force exerted between bodies or parts of bodies. If two men pull a rope they strain it and the more they pull the more it is said to be strained. Straining is not the same as stretching, for the same term would be used for a wire or rod where the stretch would not be apparent under ordinary pulls. If a weight rests on a post the post is strained. The word stress seems to be commonly used when used at all, with the same meaning as strain. But it cannot be said that the rope or the post is stressed, for the word stress, although once used as a verb, now has a very awkward look and sound. For the ordinary purposes of ordinary language strain is employed to denote an idea tolerably clear to those who use and hear it.

But when forces are studied with exactness care must be taken in the use of language. So stress and strain must be defined. Some writers, at the head of whom we may put Rankine, define stress as a force exerted between two bodies or parts of bodies, of the nature of a pull, push, bend or twist. And strain they define to be the change of shape or deformation produced by the said stress. Thus when a weight is hung on a rope it is stressed and strained; the stress is the weight and the strain is the amount of its elongation. If a load be put on a beam the load is called the stress and its bend or deflection the strain. Now it is proper and necessary that technical terms should be selected to designate these two distinct ideas, but the choice of strain to denote the stretch or change of shape seems very unfortunate on account of its conflict with the common use of the word. And in general engineers have refused to accept the definition of these writers, and have continued to use strain to denote forces measured in pounds or kilograms. No American engineer, at least, would think of saying that a bar of wrought iron *stressed* up to its breaking point ought to *strain* twelve per cent. he would certainly say that if *strained* to rupture it should *elongate* that per cent. Stress is a good word as far as it goes, but it is a word found mostly in the books, and is not often seen in engineering periodicals or often heard at the engineering conventions.

Other authors, at the head of whom we may perhaps put Stoney, define strain as force acting upon a body tending to produce change of shape. They also use the word as referring to the internal forces or resistances. If a weight be hung on a rope the weight is the strain and in all the fibres strain is produced. Stress they rarely employ, or use synonomously with strain. For the elongation or bending of the body the term deformation is employed. This method possesses the advantage of agreeing closely with common usage, and the disadvantage of using the word strain with two quite distinct meanings.

A third plan is to use the word stress for the force acting on the body, strain for the internal molecular force thus produced, and deformation as a general term for change of shape. This would seem to preserve the advantage and avoid the objections to both the other methods. The weight on the rope is a stress and in all the fibres there are resisting strains. Thus a strain is produced by a stress. A stress is an external force, a strain an internal force. When the load is placed on the post it compresses it or brings its molecules nearer together, and immediately is generated a force to resist and prevent it. The nearer together the molecules are forced by the stress the stronger becomes the repelling strain. On a beam the exterior stresses produce internal shearing and longitudinal strains. By this plan the common meanings of the two words are not distorted and distinctness is given to two really separate things.

It is an old saying that a problem throughly understood is half solved. The proper selection and consistent use of technical terms in applied mechanics undoubtedly is of great assistance in imparting clear ideas of the relation of forces in the questions investigated. Let it be understood that stresses and strains are both forces, the former known and the latter unknown, but connected with each other by the fundamental conditions of static equilibrium, and the problems of the engineer become at once clearer and hence more easily investigated.

PERSONAL.

CAPT. JAS. B. EADS and MRS. EADS returned from Europe by the Alaska on the 12th.

J. VINCENT BROWNE, formerly Contractor Chief Engineer on the Quebec Harbor Improvements, and for the past year engineer for the contractors, Beemer & Sullivan, on the Welland aqueduct, has resigned his position, and will devote his time in carrying on the contract (which was awarded to Lim and Mr. H. Griffiths) of rip rapping the banks of the Welland Canal on the summit level, a distance of about fourteen miles. The contract amounts to some $120,000. We wish Mr. Browne every success in his new work, and if we are to judge from his career of the past nine years in Canada as an engineer, success will surely attend him in his new sphere as a contractor.

NEW PUBLICATIONS.

GATE VALVES AND FIRE HYDRANTS is the title of a "handbook," compiled by A. H. Howland, C. E., and published by the Chapman Valve Manufacturing Co., for advertising purposes. It is a well-bound octavo volume of 176 pages of reading matter, besides many pages of ruled blank-note paper, for memoranda. Very naturally it tells all that can be said about valves and hydrants, information that is of great value to all parties using such articles, and also to the general public. But in addition to this purely business aspect of the book, there are some valuable essays on important subjects, and over one hundred pages are devoted to carefully selected tables and memoranda, taken from standard technical "Pocket Books," such as Trautwine's, Hamilton's and Ellis', the whole forming a most useful treatise, which must commend itself to water-works officials. All correspondence respecting the book must be addressed to the Chapman Valve Manufacturing Co., at Indian Orchard, Mass.

HARBORS AND ESTUARIES ON SANDY COASTS. By L. F. Vernon-Harcourt, M. A., Member of the Institution of Civil Engineers, London.

We have received from the author a copy of his paper on this interesting subject, in the shape of an extract from the minutes of the proceedings of the institution, April 25, 1882. The paper fills more than thirty octavo pages, and is illustrated by three large plates, each containing ten or more figures, and showing the plans and details of ten or twelve harbors, with a map of the French and Belgian coasts from Calais to Ymuiden.

The author alludes in the outset to the main cause of the formation of the numerous sand-banks along the shores of the North Sea, near the Straits of Dover, and the effects which have followed interference with the normal flow of the inshore currents. He then gives a succinct description of each of the harbors of Calais, Gravelines, Dunkirk, Nieuport and Ostend, with an account of the successive steps which have brought them to their present conditions; the effects produced by the

various works of the engineer and their motives. All these are jetty-harbors and present a remarkable similarity both in their early history and in the methods adopted for their improvement and maintenance.

The author next makes a comparison between jetty harbors and others. He refers to the interesting example of the conversion of a jetty-harbor into a large closed harbor, now being carried out at Boulogne, where an extensive area is to be inclosed by massive stone breakwaters, through which two openings are to be left of about 500 and 800 ft. respectively.

A description follows of Madras harbor, which is cited as an instance of a harbor situated on a sandy coast and inclosed by solid piers. Its general shape does not differ much from that of Boulogne, except there is but one entrance at Madras. This entrance is situated in a depth of water of 45 ft., while at Boulogne the depth at the entrances will not exceed 26 ft. The range of the tide at Madras is only 3 ft., while at Boulogne it is nearly ten times as great.

The author concludes his consideration of this topic with the statement that, "if Boulogne and Madras harbors, and other similar harbors recently constructed, fulfill the expectations formed of them, they will afford valuable evidence of the conditions under which closed harbors on sandy coasts can be maintained without difficulty, of which Kingstown harbor furnished formerly the only satisfactory example. The danger to these harbors, as well as to jetty-harbors, consists in the progression of the foreshore, as tidal scour and dredging are capable of coping with the accumulations inside."

The subject of estuaries is next taken up and illustrations of the author's views are given from the mouth of the Adour, the Seine, the Maas, the Mersey, the Scheldt, the Tyne.

The "discussion" which follows is very interesting, having been participated in by many engineers of distinction, such as Brown, Thorowgood, Hawkshaw, Redman, Hutton, Coode and others. The same may be said of the "correspondence," the names of some of the contributors being those of experts of several nationalities beside the English. On the whole, this volume of more than one hundred pages may be deemed a most instructive addition to the literature of the day on the very important subjects of which it treats.

The same author has also recently published a treatise on rivers and canals, relating to the control and improvement of rivers, and to the design, construction and development of canals. This appears as an octavo volume of 350 pages with another volume containing 21 large plates.

CORRESPONDENCE.

PRESSURE OF EARTH ON BURIED STRUCTURES.

NEW YORK, Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

Will you or some of your readers throw some light on the subject of pressures of earth on buried structures, for instance, culverts, or inform me where I shall look for such light, and oblige,

A SUBSCRIBER.

BROCK'S BRIDGE TRUSSES.—CORRECTION.

340 SOUTH TWENTY-FIRST STREET,
PHILADELPHIA, Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

In the letter of mine that you printed in ENGINEERING NEWS last week, the words "low strung" (last line), should have been "bow string."

Respectfully yours, THOS. M. CLEEMANN.

IRON BRIDGE COMPLETED.

THE CLARKE BRIDGE CO.,
No. 7 SOUTH STREET,
BALTIMORE, Nov. 16, 1822.

EDITOR ENGINEERING NEWS:

We have just completed a large iron bridge over the Savannah River for the Charleston & Savannah Railroad. There are six fixed spans of 144 ft. and a draw span of 196 ft., making a total length of 1,060 ft. We have other large contracts on hand.

Yours very truly,

THE CLARKE BRIDGE CO.

FLINT'S SURVEYING.

CITY SURVEYOR'S OFFICE,
PATERSON, N. J., Nov. 6, 1882.

EDITOR ENGINEERING NEWS:

After reading your article on "Early American Books on Surveying," in your issue of Nov. 4, I referred to my edition of "Flint on Surveying," and found that it was printed at Hartford in 1858, or six years later than you supposed the last edition was printed. We consider it one of the best text books in our office, and is put in the hands of all our new assistants in preference to any other work. The work is scarce, but it would bear reprinting.

Respectfully yours,

JOHN T. HILTON, City Surveyor.

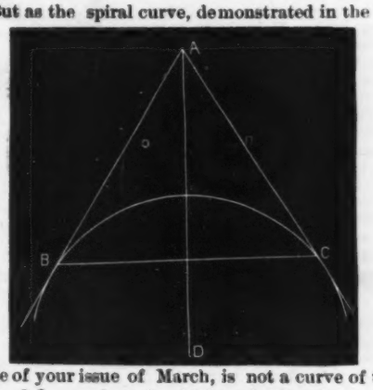
SPIRAL CURVES.

S. P. R. R., NEW GERMANTOWN, PA.

EDITOR ENGINEERING NEWS.

DEAR SIR: A curve of the second degree cannot be laid out between points *B* and *C* without it being symmetrical to axis *AD*, *BAC* being an isosceles triangle, and line *AD* bisecting angle *BAC*.

But as the spiral curve, demonstrated in the article of your issue of March, is not a curve of the second degree, but of a higher degree, it can be run in, and not fulfill such conditions.



An experiment can be tried with a spring or any elastic substance.

Finally, the best proof of the statements in the enunciation of the spiral curve is that it should be laid out in the field, as directed in the article, when it will be found to be a practical success.

W. H. FRY.

THE ST. ANNE'S RIVER BRIDGE.

TORONTO, Canada, Nov. 13, 1882.

EDITOR ENGINEERING NEWS:

The contract for the bridge superstructure over St. Anne's River, on the Quebec & Lake St. John Railway, P. Q., was closed by the Board on the 7th inst., with the Toronto Bridge Company, represented by Job Abbott, President and Engineer. The clear span is 221 ft., and the bridge will be built with steel upper chords, posts, floor beams and stringers; the tension members being of Nova Scotia iron, manufactured at Londonderry, N. S. As you have heretofore credited this work to Clarke, Reeves & Co., Philadelphia, kindly insert above and oblige.

Yours truly, JOB ABBOTT.

WHICH IS IT?

BACKWOODS, Canada, Nov. 9th, 1882.

EDITOR ENGINEERING NEWS:

In last week's issue J.E. Castbergh, draughtsman, asks, "Engineers what is your opinion," on a portion of Mr. Trautwine's book.

As the book is in its "sixteenth thousand," I think there can be no two opinions as to its merits. I have read the portion alluded to and never thought it either a "mathematical failure or practical absurdity." Truly, one either must be hypercritical or else desirious of a little cheap notoriety, to make so "much ado about 'nothing or O.'" Engineers, what *are* your *opinions* on this?

Respectfully yours, S. L. P.

WHICH IS IT?

WASHINGTON, D. C., Nov. 8th, 1882.

EDITOR ENGINEERING NEWS:

In response to Mr. J. E. Castberg's inquiries in No. 44 of ENGINEERING NEWS, I would like to answer that Mr. Trautwine is correct as regards "shorten it to zero" as a comparison with any text book on mechanics will show. Yet I offer the following practical illustration of the "theoretical" action of a weight equal to the modulus of elasticity.

As he may be well aware the modulus of elasticity is that figure which tells us the change a body (a bar) of one square inch (unit) section undergoes in length under the stress of one pound (unit) of weight.

Take for instance a "*wrought*" iron bar 1 ft. long, one square inch cross section suspending 1 lb. As the modulus of elasticity for tension is say 27,000,000 lbs. it means that the above bar is extended or lengthened $\frac{1}{27000000}$ of a foot (of its length) under the given conditions; therefore it is evident that if I would suspend 27,000,000 lbs. from that bar it would be extended *one* foot. Its total length would now be two feet or twice its original length.

Likewise in case of compression, (modulus of elasticity being the same as for tension), if a weight of *one* lb. is pressing on the above bar it will be compressed $\frac{1}{27000000}$ of a foot. If then a load of 27,000,000 lbs. is put on, it would evidently compress the bar 1 ft. or in other words would reduce it to nothing or zero.

But it is evident that in neither case such is possible; it is merely a theoretical deduction; moreover under the assumption that in either case and under that excessive load, the bar would not alter its cross section nor be destroyed.

Your inquirer is therefore wrong in calling "and shorten it to zero or 0", "a mathematical failure" it is not a mathematical but *practical* failure and physical impossibility.

Hoping that the above explanation is satisfactory to him as regards the point in question, I remain Respectfully,

E. SCHMITT.

EARLY LOCOMOTIVES.

NEW YORK, Nov. 15, 1882.

EDITOR ENGINEERING NEWS:

The statement in your last issue that Mr. Toucey has been succeeded as Superintendent of the New York Central R. R. is incorrect, as he informed me to-day, in his office. He has, however, appointed Mr. Franklin as Depot Master.

I am reminded in this connection of the first experiments made with coal-burning locomotives on the New Haven R. R. by Wm. E. Worthen, Esq., who was then, 1853, Vice-President and Engineer.

Mr. Whistler, as superintendent, brought from the Baltimore & Ohio R. R. two of their camel back freight engines for trial on the New Haven road, and it was my pleasing and instructive duty to ride on the night freight train (Jo Franklin, conductor) from New York to New Haven and return to gauge the water in the tank at each station and weigh the coal (Cumberland) used on each round trip.

These clumsy machines carried terror along their course. The exhaust scattered live coals far and near, to the great danger of fences, bridges and buildings, as well as clothing, and although the tests showed superior traction power, they were soon laid by, supplanted by more modern coal burners.

JOHN AVERY.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 387.)

CCCCVII.—ST. JOSEPH, MO.

St. Joseph, Missouri, in lat, 39° 45′ N. long. 94° 53′ W., is on the Missouri River. The bluff at this point recedes about 5 miles from the river bank, and the city is on the "bottom" lands. It was settled in 1843 by Joseph Robidoux, and incorporated as a city in 1850.

Water-works were built by a private company in 1880, after plans and under superintendence of John W. Rutherford, C. E., taking the supply from the Missouri River, at a point 3 miles from the city, across a neck of land but 10 miles above the city by the course of the river. Two Worthington duplex steam pumps, each of 3,000,000 gallons capacity lift the water 320 ft. through 1,196 ft. of 16 in. cast-iron pipe into a reservoir in excavation and embankment with the inside slopes lined with one course of brick on edge, on 18 in. of puddle. After 48 hours subsidence, it is drawn into another reservoir whence it is distributed. The effluent main to the city, 2¼ miles, is 20 in. and there are 24

miles of cast-iron distribution pipe of 20 to 4 in. diameter, with 212 fire hydrants, 182 gates and 553 taps. There are 27 meters in use. The city pays annually $100 for each of 160 fire hydrants and $60 for each above that number. Service pipes are of lead.

The population in 1880 was 32,484. The daily consumption in 1882 is 2,500,000 gallons.

The capital stock of the company is $400,000. The works have cost $850,000. The bonded debt is $400,000, at 6 per cent. The expenses and receipts are not furnished for publication.

T. J. Clew, Jr., is Secretary, and Theo. W. Davis the Superintendent.

CCCCVIII.—CONSTANTINE, MICH.

Constantine, Michigan, in lat. 41° 53′ N., long. 85° 41′ W., is on level ground, on the St. Joseph River. Settled in 1828, it was incorporated in 1861.

Water-works were built by the village in 1878, taking the supply from Fawn River, a tributary of the St. Joseph, a dam across which affords a water-power of 15 ft. head, one-twelfth of which is owned by the village and is used to drive a double-acting pump which forces water directly into the mains. The ordinary pressure is 25 lbs., and the fire pressure 120 lbs.

Distribution is by 4 miles of Wyckoff wooden pipe, of from 10 to 4 in. diameter, with 37 fire hydrants, 18 gates and 41 taps. Service pipes are of galvanized iron.

The population in 1880 were 2,100. The consumption is not stated. The works have cost $20,500. The bonded debt is $10,000, at 5 per cent. interest. The expenses in 1881 were $250. Most of the distribution pipe were not laid until 1882, and the revenue is not yet fairly established. The works are managed by the village council.

CCCCIX.—CARLISLE, PA.

Carlisle, Pennsylvania, in lat. 42° N. long. 77° W. is in a broken and rocky region. It was settled about 1750 and incorporated as a borough in 1782, and the charter amended in 1814.

Waterworks were built by a private company in 1854 after plans of A. T. Smith, taking the supply from Conodguinnet Creek three miles from the town. A dam across the stream furnishes power to drive a Leffel turbine of 6 ft. diameter, with 4½ ft. head and fall, operating a horizontal piston pump of 300,000 gallons daily capacity, made by F. Gardner, which lifts the water 125 ft. through 6 in. cast-iron pipe to two reservoirs built in excavation and lined with brick masonry, each 124 by 132 ft. and 12 ft. deep, on a hill midway between the pumps and the town, and 74 feet above the town.

Distribution is by 12 miles of cast-iron pipe of 8 in. diameter from the reservoir to the heart of the town, and the rest from 6 to 3 in. diameter, with 61 fire hydrants, 29 gates and 550 taps. Lead service pipes are used.

In the winter of 1881-2 a Dean Brothers' steam pump was added to the pumping works.

The capital stock of the company, which supplies both gas and water, is $62,025. The Borough owns one-third of the stock, and elects three of the nine directors. Prior to 1882 no charge was made for water for public uses, but it is now proposed to charge the borough $250 per year for use of fire hydrants.

The population in 1880 was 6,198. The daily consumption is 125,000 gallons. The bonded debt is $25,000 at 6 per cent. interest. The gas and water works have together cost $99,660.73. The expenses of maintenance for the year ending May 1, 1882, chargeable to water account, were $1,808.19, and the receipt from water rents $5,366.90.

John G. Heiser is the Secretary and Superintendent.

CCCCX.—WELLSVILLE, O.

Wellsville, Ohio, in lat. 40° 30′ N., long. 81° 30′ W., is on the Ohio River. The town is on the "bottom" lands and surrounded by hills rising from 200 to 500 ft. above the river.

Settled in 1823, it was incorporated in 1829.

Water-works were built by the city in 1881, after plans of Edaburn & Cooper, and under superintendence of John A. George, taking the supply from the ground water below the bed of the Ohio River. A crib, 12 by 16 ft. and 10 ft., deep made of oak timbers 8 by 10 in., is sunk in the river, 100 ft. from the shore. In the bottom, eleven 4-in. cast-iron pipes, 12 ft. long, perforated for 3 ft. from the lower end, and the end closed with a pointed wooden plug, are driven 10 ft. into the sand and gravel. Through these pipes, which project upward two ft. into the crib, the water flows into the crib and is conveyed to the suction-pipe.

Two Worthington duplex steam pumps, of 18½ in. steam and 10¼ in. water, cylinders of 10 in. stroke, lift the water 334 ft. to a reservoir built in excavation, with the bottom covered with broken stone on 20 in. of clay puddle, and the slopes lined with 4 in. of brick on 15 in. of puddle. It is circular, with bottom diameter 106 ft., and diameter at flow line 17½ ft. above bottom, 182 ft. The pressure in the turn is 120 to 130 lbs. The force main is 10 in., and the distributing main 8 to 4 in. diameter, of cast iron, and some wrought iron of 2 to 1 in. diameter. There are 6 miles of pipe, with 42 fire hydrants, 31 gates and 400 taps. Service pipes are of lead. The population in 1880 was 3,377. The daily consumption is not known.

The works have cost $60,000, which is the bonded debt at 6 per cent. interest.

No statements of expenses and revenue have yet been made.

The works are managed by three trustees. D. D Davidson, one of the trustees, is the secretary.

CCCCXI.—JAMESTOWN, N. Y.

Jamestown, New York, in lat. 42° 8′ N., long. 79° 15′ W., is at the outlet of Chautauqua Lake, on hills rising from the stream to a height of about 200 feet.

Settled in 1810, it was incorporated as a village in 1827.

Water-works were built in 1882 for a private company, by the Holly Manufacturing Company, taking the supply from a well, 21 ft. diameter and 21 feet deep, connected by 100 ft. of 16 in. pipe, with a basin 80 by 120 ft. In the bottoms of these wells are driven twelve 3 in. pipes to a depth of 60 feet, through which the ground water flows into the wells. A Holly engine, with four pumps of 9 in. bore and 27 in. stroke, pumps directly into the mains, with an ordinary pressure of 90 lbs., and fire pressure of 150 lbs. at the pumps. The highest fire hydrant is 165 feet above the pumps.

Distribution is by 13 miles of cast-iron pipes of from 16 to 4 in. diameter, with 100 fire hydrants 39 gates and 375 taps. Three meters are used. The village pays $60 per year for each fire hydrant. Service pipes are of wrought iron coated with coal tar.

The population in 1880 was 9,335. The daily consumption is not yet determined.

The capital stock of the company is $150,000. The works have cost $140,000, and there is a bonded debt of $100,000 at 6 per cent. interest.

A. F. Kent is the Treasurer and Superintendent.

(TO BE CONTINUED.)

CORRECTIONS AND ADDITIONS.—Nov. 4, p. 381, *Gunnison, Col.*—Statistics furnished by D. J. McCanne, Superintendent, who designed the works, differ from those previously furnished by C. E. Gray, Jr., in the following points: A wing dam of timber and stones diverts the water of the river into a conduit 12 by 20 in. inside and 2,700 ft. long, made of red spruce lumber with tongued and grooved joints put together with coal-tar pitch. This leads to the pump well, 16 by 10 ft. The Worthington compound engine has steam cylinders of 12 and 18 in. and water cylinder of 10¼-in. diameter and 10-in stroke. The high-pressure engine has 16-in. steam and 10¼-in. water cylinder of 10-in. stroke. Water is pumped 185 ft. into a tank of red spruce plank, holding 65,000 gallons on the hillside 165 ft. above the city. In the distribution the company have laid recently 4,000 ft. of wrought-iron pipe. There are 36 fire hydrants, 10 gates and 60 taps. The city pays $100 per year for each hydrant. The daily consumption is 30,000 gallons. The works have cost $200,000. The operating expenses are now $167 per month.

The receipt of statistics, as follows, is acknowl with thanks: From J. W. Rutherford, C. E., statistics and water rates of the water-works of St. Joseph, Mo. From Thomas Harrison, Village Recorder, statistics of the water-works of Constantine, Mich. From D. D. Davidson, Secretary W. W., statistics of the water-works of Wellsville, Ohio. From J. G. Heiser, Superintendent Gas and Water Co., statistics of the water-works of Carlisle, Pa. From F. F. Davis, statistics of the water-works of Coatsville, Pa. From A. F. Kent, Secretary and Treasurer statistics and water rates of the water-works of Jamestown, N. Y. From D. J. McCanne, Superintendent, statistics and water rates of the water-works of Gunnison, Colorado.

THE CAISSON DISEASE.

[From the St. Louis Globe-Democrat, Sept. 27.]

The sufferings of Chief Engineer Roebling, of the East River bridge, New York, from the caisson disease, recall to mind the trouble that was experienced here in the building of the structure across the Mississippi, when the men employed in the construction were stricken down with the malady. Three of the four piers of the St. Louis bridge are in the river, and had to be built on caissons made of very thick iron with an air-chamber. To reach this air-chamber the men descended a flight of circular stairs in a shaft in the centre of the pier. On arriving at the bottom of the pier they entered what is known as the air-lock by a door at the north side of the shaft. The air-lock was a cylinder 6 ft. in diameter and 6 ft. high, made of very thick iron. Besides the door leading to it from the shaft, there was another door at the east side of it that led into the air-chambers. After the bed of the river was reached, men worked in the caissons at clearing away the sand and earth, so that the piers could rest on solid rock. Once the rock was reached the caissons had to be filled in with concrete so that the piers could rest on the rock and solid masonry. The lower the caisson was sunk the greater was the atmospheric pressure, and when the east pier touched the river bed the pressure was 17 pounds to the square inch, exclusive of the 15 pounds ambient atmosphere. It gradually increased, and when the east caisson touched the rock on the 28th day of February, 1870, the pressure was 45 pounds to the square inch, and by the rise of the river during the months of March and April it was increased still more, the pressure being 50 pounds to the square inch on April 12. As so great a pressure of air could not be otherwise than injurious to the men at work in the caisson, they were only worked for two hours when they were relieved for two hours, and this was kept up for 12 hours, so that they were in the chamber but six hours a day. After the caisson of the east pier had been sunk 15 ft. in the sand, and the pressure had reached 24 pounds to the square inch, the men, after coming out of the air-chamber into the air-lock, or after leaving the air-lock and returning to the normal atmosphere, commenced to suffer very severe pains in the arms and legs, and sometimes shooting pains in the back.

When the caissons had sunk to a greater depth, and there was a pressure of 34 lbs. to the square inch, the men became more seriously affected, some with violent epigasiric pains, others with paresis, and still more with slight paraplegia, of which they generally recovered in 24 or 48 hours. Sometimes the paraplegia was more severe, and some of the men were taken with still more serious symptoms. Notwithstanding the existing paralysis, some of them complained of violent pains about the middle of the spine and radiating in every direction of the lower half of the body. As soon as cases happened means were devised at the bridge to relieve the sufferers if possible, even temporarily, and afterward they were sent to the City Hospital. The first case sent to the hospital was on the 15th of February, 1870. Some died shortly after their arrival at the hospital, and some after a sojourn there.

After the recurrence of such facts and accidents, physicians were called at the bridge to see the men at work, when taken sick, which was generally the case when coming out of the air-lock, or after returning into the normal atmosphere. None were taken sick in the air-chambers, and the sufferers were generally taken in a few minutes to one hour after they returned into the normal atmosphere, and in two cases only did it occur in the air-lock, as soon as the door opened into the normal atmosphere, and not in the air-chamber or caisson.

Dr. Jaminet was placed in charge of the men at work in the air-chambers April 1, 1870. He had descended into the caisson several times before with other gentlemen, and experimented upon the effect upon himself and others, and knew the exhausting effects. On one of his visits to the caisson, Feb. 28, he remained two hours and forty-five minutes in the air-chamber. The caisson had then touched rock, and was 95 ft. below the river surface, and the pressure of the air was 45 pounds to the square inch. The temperature in the normal atmosphere was 34°; at the bottom of the shaft it was 48°. It rose to 68° when the doctor entered the air-lock, and fell again to 45° on entering the air-chamber. His pulse rose from 82 beats to the minute to 102 in the air-lock, but again fell back to 82° in the air-chamber. His respiration was 21 per minute. After leaving the caisson and returning to the top of the pier his pulse rose to 110 beats per minute. He had to rest several times going up the stairs, so exhausted was he, and he almost fainted when he reached the top of the pier. It was with the greatest difficulty that he managed to reach home, and when he did he fainted several times, and lay for hours in a helpless condition, suffering the most acute pains. He was paralyzed and unable to move himself. He took frequent doses of Jamaica rum, beef tea, and also used ice. After several hours suffering the pains began to leave him, and he slept a little. It was a week, however, before he had fully recovered his strength.

On taking charge of the men he had their time changed so that after working two hours they would be given three hours' rest before returning to the caisson. They still, however, continued to work six hours per day, the only change being an hour's longer rest after each interval of work. The men were made to remain 16 minutes in the air-lock before entering the air-chamber, and eight minutes in the air-lock again before returning to the outer atmosphere. This was giving them a minute to every six pounds of pressure going in and a minute to every six pounds of pressure coming out. A floating hospital was arranged at the east pier, and the men were taken to it as soon as stricken down, and attended. No case occurred under his system until April 4. It was noticed that the men suffered greatly from exhaustion. It was also observed that whenever a man took sick immediately after leaving the air-chambers, his pulse was 95 to 115 per minute and very feeble.

When, however, it happened that they did not take sick until a lapse of 20 minutes or longer, the pulse was very slow, often being as low as 60 per minute. In both cases they were covered with cold profuse perspiration. In most of the serious cases the legs were cold and the skin clammy. The temperature was otherwise unchanged. The face was pale and livid and the lips discolored, but the pupils remained unchanged. After the patient had been lying down five or ten minutes at perfect rest, with his legs more elevated than his head, this all changed.

Dr. Jaminet directed that the workingmen, as soon as they came up from the air-chambers, should rest and keep quiet for an hour, and if any were taken sick his treatment was as follows: The patient was put in bed, lying on his back or right side, the head low—level with the body—the legs stretched, the feet elevated at least one foot above the head, and all clothing loosened. He prescribed half an ounce of the following cordial, which always relieved the violent epigastric pains:

R. Spiritus Jamaicensis, viii. fluidounces.
Syrupus simplex, ix. fluidounces.
Oleum anisi, ii. fluiddrams.

After taking this cordial, and from 5 to 10 minutes after, it was followed by two tablespoonfuls of beef tea (made with Liebig's extract of meat in the proportion of one dram to six ounces of boiling water), two tablespoonfuls were given from 5 to 10 minutes, and as the patient always after a while complained of thirst, ice was freely used, but no water or any other drink was allowed for at least two hours. The beef tea was continued regularly; the position of the patient was still adhered to; but afterward the legs were left in the most comfortable position as soon as the pulse was getting stronger and less frequent—that is to say, for the cases where the pulse was over 95 per minute and feeble, and more frequent in the cases where the pulse had fallen as low as 60 per minute. Then, and not until then, was the patient allowed to change his position.

The necessity of placing the patient on his back with the head low and the feet elevated was to send more stimulus to the brain and prevent a return of syncope. which sometimes happened, and which, if repeated in a state of exhaustion, might have had a fatal termination. And when the position was alternately changed from the back to the right side it was to relieve the spine, and at the same time to let the heart resume its regular function, which was more or less dirturbed at the time the patient was taken sick. No bath of any kind was given to any of the sufferers, having been positively forbidden.

At first Dr. Jaminet was unable to control the men when coming up from work, and instead of resting as directed they would insist on moving about, and many of them went ashore and drank very freely. As a consequence 32 cases occurred between April 4 and April 25, but after that the doctor got control of the men and the cases were less frequent. Out of the 28 cases which occurred during the sinking of the east abutment caisson 27 recovered completely and many returned to the same work. The only death which occurred was caused by the failure of the men to follow the directions laid down for the man working in the air-chambers. It was demonstrated that men of low or medium stature, well built, single and of steady habits stood the work best. Dr. Jaminet thinks that if every man is properly examined as to his fitness before being placed at work, and the proper precautions are taken, there need be no fatal cases of caisson disease.

NEW YORK, WEST SHORE & BUFFALO RAILWAY.

The construction of this new Trunk line continues to progress very rapidly and satisfactorily between Weehawken and Syracuse, 278 miles; also on its branch lines to Middletown, 25 miles; and Albany, 13 miles, making in all 316 miles now rapidly nearing completion. At this time about 85 per cent. of the graduation and masonry is completed. On the 8th inst. the interval between the last two "headings" of the tunnel of 3,985 ft. through the Bergen Hill, at Weehawken, was cut through, so that at the present time there is an opening through its entire length, and only about 5 per cent. of the total amount of excavation in it yet remains to be done, which will be completed early in next month. The average force employed upon this tunnel and its approach cuts during the month of October was 425 men, 28 compressed air drills, 2 steam excavators and 4 locomotives. The total number of cubic yards of material to excavate from this tunnel and its approach cuts was about 378,000, of which about 345,000 is now completed. The Haverstraw Tunnel, of 1,600 ft. in length, is entirely completed; and the West Point Tunnel, 2,640 ft., now lacks but 30 ft. of being entirely through, which will be completed before the end of the present month. The small tunnels at Newburgh and Kingston, of about 400 ft. each, are both progressing very rapidly.

Iron bridging to the amount of 12,000 tons is manufactured, and most of it delivered at sites for erection. Erection is progressing rapidly all along the line, not less than 6,000 tons being already in place. Tracklaying is in progress at twelve different points, and about 130 miles of tracks are laid up to this date.

The building of passenger and freight stations, engine houses, machine shops, and the houses and appurtenances for the supply of water and fuel, is also being prosecuted with much vigor at all of the following places: Weehawken, New Durham, Newburgh, Milton, Haverstraw, Kingston, Glenerie, Catskill, Coxsackie, New Scotland, South Schenectady, Coeymans, Canajoharie and Canastota; and at all other points the buildings are being placed under contract just as rapidly as the Engineering Department can prepare the plans and contracts for them.

The total average force employed on the work during the month of October was as follows:

19,300 men, 67 steam and compressed air drills, 19 steam excavators, 3 dredging machines. Equivalent to a total force in men of 23,200. In addition to which were employed 3,450 horses and carts, 32 locomotive engines, 1,438 cars, 14 pile-drivers, 63 steam derricks, 6 steam pumps and 32 tug boats, barges and scows.

WALTER KATTE, Chief Engineer.

WEIGHT OF MEN AND WOMEN.

WEIGHED AT THE TENTH CINCINNATI INDUSTRIAL EXPOSITION, OCTOBER, 1882.

It will be remembered that permission was given the Department of Scientific and Educational Appliances to employ a clerk to record the weights of men and women being weighed on scales in the exhibit of the Howe Scale Company. The sheets containing the record have now been added up and the committee reports as follows:

The object sought was a determination of the average weight of men and women, a fact often required by civil and mechanical engineers. Haswell states that the average weight of 20,000 men and women, weighed at Boston in 1864, was—men, 141¼ pounds; women, 124¼. We have always thought these weights too low for Western people.

The number weighed at the Tenth Cincinnati Industrial Exposition was		22,155
		Pounds.
And the total weight		3,072,306
Men weighed, 7,467	weight	1,150,108
Women weighed, 14,688	"	1,922,198
Average weight of men		154.02
Average weight of women		130.87

For men this is 12.52 lbs. higher than the Boston average and for women 6.37 lbs. higher.

We also determined with reasonable certainty the average weight of people from the country, independently of the general average. This was rendered possible by the excursions that were coming here at various times from this and the adjoining States, parts of which were weighed.

FOR OHIO.

	Pounds.
Average weight of 141 men was	157.38
Average weight of 179 women was	133.26

FOR SOUTHERN INDIANA AND ILLINOIS.

Average weight of 124 men was	158.52
Average weight of 193 women was	133.55

FOR KENTUCKY.

Average weight of 114 men was	158.43
Average weight of 188 women was	133.76

The mean of these averages is so much above the general average as to attract attention. For men it is 5.09 lbs. higher and for women 2.65 lbs. The very high and approximate average of those from Southern Indiana and Illinois and from Kentucky recalls the Kentucky origin of the former.

We are under obligations to the proprietors of the scales for furnishing assistant weighers, thus enabling the work to proceed continuously.

W. A. COLLORD, Chairman.

CINCINNATI, Nov. 1, 1882.

CONTRACTING IN BRAZIL.

It is clear from the events of late years that government contracts in Brazil are becoming very risky enterprises, and it is time that foreign capitalists should know that fact. Complaints have been made here over and over again, but to no purpose whatever. To a government official a contract has only one purpose—the carrying out of certain projects on the government's own terms. The contractor is used simply to furnish the money and do the work; his rights under a contract are neither respected nor observed. He undertakes to accomplish a specified work for a specified sum of money, and then the government deliberately ties his hands, makes him subordinate to official engineers and fiscals, delays his work at will, fines him for infractions of contract caused by its own fiscalizing regulations, changes the plans at pleasure, adopts its own standard of measurement, and then delays or denies payment at its own sovereign will. The government never admits that when it enters into a contract with a private party, that party becomes its equal before the law. On the contrary, the government carries its sovereignty into the execution of all its contracts. And then when the contractor seeks to secure justice in the courts, the government forbids the interference of the court, as was done during the administration of Buarque de Macedo. If other proofs are needed of the justness of these criticisms, we may also refer to the action of the government in the contract for the surface drainage works of this city, in those for the construction of the Bahia, Pernambuco and Rio Grande railways, and in a multitude of small contracts with which every one is familiar.

The only conclusion to be drawn from these occurrences is, that a contract with the Brazilian government has become a very risky piece of business.—*Rio News, Oct.* 15.

THE EAST RIVER BRIDGE.

At the Trustees' meeting on the 13th, the contract to furnish an ornamental railing for the towers around the promenade was awarded to the Composite Iron Company for $2,999.60. H. K. Porter & Co., of Pittsburgh, got the contract for two motors at $4,600.

The total cost of the bridge up to the present time is $14,045,683.86. The receipts from all sources up to date are $14,072,703.16. The outstanding liabilities are $127,969.26; the cash on hand is $27,019.30.

President Murphy reported that 668 tons of steel had been received during the month from the Edge Moor Iron Company; that 148 tons were on the way, and that 700 pieces, amounting to nearly 60 tons, were yet to be shipped. He announced that the contract would be finished at the works on the 14th.

Mayor Low and Comptroller Semler accepted on the 13th the proposal of W. F. Pitkin for $200,000 of four per cent. bridge bonds at 103.25, and of A. Dougherty for $36,000 of bonds at 107.

LITERATURE.

The North American Review for December commands attention no less by the eminence of its contributors than by the value and timeness of its table of contents. First, there is a symposium on "The Health of American Women," regarded from three distinct points of view: Dr. Dio Lewis considers the question as it is affected by the prevailing style of feminine attire, especially by the practice of tight lacing. Mrs. Elizabeth Cady Stanton points out the many injurious influences of social environment; and Dr. James Read Chadwick sets forth the effects of education, climate and food, and finally discusses the question whether the modification produced in the European human type by transfer to America lessens the fertility of women. Gov. Buren R. Sherman, of Iowa, writes of the "Constitutional Prohibition" of the liquor traffic in that State, and maintains that the measure is in entire accord with the traditions of the original settlers, and approved by men of all political parties and all nationalities. General Grant, in an article entitled "An Undeserved Stigma," states the facts of Gen. Fitz John Porter's case, and argues that the sentence of the court martial that cashiered him was based on a misconception of the essential circumstances. Richard A. Proctor writes of "The Influence of Food on Civilization," discussing with much learning and force some of the most interesting sociological problems of the present day and of the near future. Prof. Fisher, of Yale College, in defining the causes of "The Decline of Clerical Authority," holds that this decline, which affects the status of church and minister only as a part or function of the secular State, is by no means to be regretted, and that the spiritual influence of the church and its ministry is to-day greater than of old. Finally, there is a symposium upon the conditions of "Success on the Stage," the contributors being six of our most prominent actors—John McCullough, Joseph Jefferson, Madame Modjeska, Lawrence Barrett, Maggie Mitchell and William Warren.

NOTE

TIME BY TELEGRAPH.—The Time Telegraph Co. has introduced a system of clocks by which it is proposed to furnish railway stations, public institutions, business houses, places of amusements, etc., with correct time at a moderate cost, varying from 25 cents to $1 a month, according to the character of the timepiece. The system is practically the same as that already introduced in Paris with complete success. The pendulum of a central regulating clock, which stands in the company's office and runs exactly according to time as furnished from the National Observatory at Washington, opens and closes an electric circuit with every beat, or once a minute if desired. This circuit may pass through any number of clocks, situated all over the city. Every time the circuit is closed a magnet in each clock causes the wheel which carries the minute-hand on its pinion to advance one tooth. Most clocks will be supplied with minute-hands only, but where second-hands are needed the circuit will be closed every second.

The first regulator made for the company is now in their offices in the Kelly Building. It was made by Professor Eggleston, of Columbia College, and runs by electricity—a magnet which alternately attracts and repels the pendulum, causing it to swing back and forth, thus doing away with weights and springs. The company proposes at present to put one regulator in each block, so as to

avoid having to cross streets with their wires; but eventually the whole system will be regulated from one central clock. The clocks to be furnished are handsome but very cheap, the cases being of glass and in one piece. The movement is simple, composed of a magnet and a simple ratchet movement, so that there is no danger of the machinery getting out of order. The clocks will do their work correctly so long as the batteries are kept in working order, and it is not expected that they will need replenishing more than once a year. The Pennsylvania Railroad Company, after testing the system for more than a year, has decided to introduce the clocks all along its line and run its trains by them. The importance of having the time in all public places, in hotels and railway stations the same, is too self-evident to need argument. The company is now at work putting in clocks in the block bounded by Beekman, Nassau and Ann streets and Park Row. —*New York Evening Post Nov.* 10.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

EQUITABLE GAS CO., OF NEW YORK.—"Considerable sensation is likely to be created by a new company incorporated under the law of the State of New York and under the name of the Equitable Gas Company of New York. The officers of the company are Edward Sterne, President and J. R. Keene, Vice-President. Messrs. Brewster, Archbold and Rockefeller, all of the Standard Oil Company; E. N. Dickerson, the lawyer, and E. Jerzmanovsky, the engineer, compose the Board of Directors. The company is a close corporation, and the whole capital, $2,000,000, has been subscribed for by the promoters. The object of the company is to produce gas by the decomposition of steam and liquid hydro-carbon on highly heated lime. Almost pure hydrogen is thus obtained, the lime, used over and over again, being constantly revivified by heat. The hydrogen thus produced is carburetted in the usual way, and gives a gas of between thirty and fifty candles power. All former attempts at producing hydrogen gas on a large scale for illuminating, heating and other power-producing purposes have utterly failed on account of the high cost of production. The main feature of this process is rapid production at very low cost and with very little labor. The process is the discovery of that old genius, Tessié du Motay, who died some two years and a half ago in a lodging house in Twenty-sixth street—and died poor, of course. In partnership with a young Polish engineer of the name of Jerzmanofsky, the famous French chemist took out a patent for his process. Mr. Jerzmanofsky has been working ever since the death of Tessié du Motay to perfect this process, and obtained results which were brilliantly illustrated at the exhibition given at the experimental works of the Municipal Gas Company on Tuesday last. Officers of different gas companies were present, and expressed unqualified admiration of the new process. All publicity in regard to the scheme has been avoided, and it was with considerable difficulty that this information was obtained, the object of the promoters being 'to keep the whole thing to themselves.' The company has become the owner of an exclusive license for the city and county of New York, and as soon as the necessary buildings are erected will supply the city with the new gas, at considerably reduced cost to the consumers. The Municipal Gas Company, of which Mr. E. Stern is the originator, has secured a free license for the consumption of the new gas. 'The brilliancy of our gas, and its low cost of production,' said an officer of the company, 'will make it the most formidable competitor of electric light, even should that light become an absolute practical success. Our gas will be so cheap that it will be used for fuel, and in a very few years you will see it substituted for coal on steamboats and railroad engines, if not in kitchens. We shall knock down the price of coal, too, for we furnish a clean, unsmoking substitute for it, and don't use a ton of coal ourselves. All the heating we want is done with oil.'

"The process has been patented in every country, and the great Paris banking house of Baron Sellière is conducting the negotiations for the introduction of the new gas in Russia, Germany, Austria, France and Italy. England and Belgium being the two great coal-producing and coal-consuming countries, the patentees have as yet reserved to themselves all negotiations for them."—*N. Y. Sun.*

CROTON WATER METERS.—According to the decision rendered on Monday by the Superior Court, Special Term, the Commissioner of Public Works may have meters put in "all stores, workshops, hotels, manufactories, public edifices, at wharves, ferry houses, stables and in all places in which water is furnished for business consumption by the Department of Public Works, except private dwellings." Whether a meter shall be put in any building or not is a question whose decision rests solely with the Commissioner, except that a court will interfere to prevent any abuse, injustice or oppression. But the pattern and cost of the meter must be approved by the Mayor, the Comptroller and the Chief Engineer of the Croton Aqueduct. In the case before the court it appeared that the water used for business purposes was drawn from a well, and that the Croton water was used only for drinking, washing, etc. It was accordingly contended that the owner of the premises could not be charged with the cost of putting in a meter, as no Croton water was used for business purposes. But the Court decided that meters may be put into any of the kinds of building specified, when the occupants have it within their power to use more than the usual allowance of water. "The power and the temptation," says Judge Freedman, "to use the Croton water in their business exists, and the Commissioner of Public Works is not to be expected to provide and maintain an efficient system of espionage or regular inspection at short intervals to prevent them from making the most of their opportunity. It is the office of the water meter to prevent such a result."—*New York Herald, Nov.* 15.

HYDE PARK, Ill., is discussing the question of adequate street illumination. The gas works are inadequate and it seems probable that electricity will be tried.

A PETROLEUM pipe line constructed from the Couban oil territory over the Caucasus mountains to Novorossisk harbor, on the Black Sea coast, is 105 miles long, and can deliver every day 1,000,000 lbs. of petroleum.

ELECTRICITY.

THE Cairo (Ill.) Electric Light and Power Company has been incorporated. Capital $10,000.

THE Freeport Electric Lighting and Power Company of Freeport, Ill., has been incorporated. Capital, $25,000.

A CANADA ELECTRIC COMPANY.—Application has been made for the incorporation of the Canadian Magneto Electric Light Company. Capital $100,000.

RAILROADS.

BOLIVIAN RAILWAYS.—The latest advices from Bolivia announce that a most important railway project has been presented to the government by two Argentine citizens, Messrs. Rossetto and Aurrecochea, who have proposed the construction of a railway from La Paz to the frontier of Saquixea, joining with the Argentine Central Northern. The city of Sucre would be connected by a branch line with the railway, as well as Potosi. Thus the railroad would start from the centre to the south of Bolivia.

The branch line from Sucre to the main line would be a tolerable easy work, but the extension to Potosi would have to take a roundabout route to avoid the great difficulties of the surrounding mountainous country. The proposed line would thus unite the principal cities and richest districts in the republic of Bolivia and facilitate the transport of the greater bulk of produce to the port of Rosario along the Central Northern and Central Argentine. At present all the produce of the southern provinces of Bolivia is transported by bullock-carts to Tucuman, a long and tedious journey, and most expensive means of transport.

The contractors propose to construct the line without any subvention from the government and request no guarantee whatever on the capital. They only ask for the concession of 24 square degrees of national lands. The government thus goes to no expense, and the railway will be worth more to Bolivia than all her public lands.

The proposal of the concessionaires is so advantageous that the Bolivian government and Congress will no doubt immediately sanction it; but the success of this enterprise hinges more on the foreign capital than on the efforts of the Bolivian government. The Bravo scheme is yet remembered by all, and that gigantic concession fell through owing to want of confidence abroad. —*Buenos Ayres Standard, Sept.* 28.

THE Canada Southern Railroad has been leased to the Michigan Central Railroad Company for 20 years.

GRADING IN PENNSYLVANIA.—The grading of the Phœnixville & Westchester Railroad is being pushed with great vigor.

A WESTERN ROAD.—Ground was broken for the San Francisco and San Rafael Broad Gauge railroad at the mouth of the 1,900-ft. tunnel. The contract includes three tunnels, 1,900, 1,050, and 600 ft. in length each. When the road is completed, San Rafael will be within fifty minutes' ride of San Francisco. The road will come to deep water at Point Tiburon, just above Sausalito, and is the commencement of vast improvements. The contractor intends to finish this part of the road within one year.

WORK ON THE KILLBUCK VALLEY ROAD PROGRESSING.—WOOSTER, O., Nov. 9.—The work of grading the Lake Erie, Wooster & Muskingum Valley Railroad, more commonly known as the Killbuck Valley Road, between this place and the New York, Pennsylvania & Ohio Road, at Burbank, is progressing rapidly. Over half of the 15 miles is all graded and ready for the ties. The worked is being pushed forward with a large force of hands, and it is expected to have the road-bed ready for the rails by the 1st of January. The completion of this little road is now assured.

THE Mexican Southern Railroad will start at Anton Lizardo, where the company now own a very large tract of land, where a harbor can be formed very cheaply, and where the new port of entry, "Grant City," is expected soon to rise. Thence it will run, via Arenal and Puebla, to the City of Mexico, and from Arenal, via Oaxaca, to the Isthmus of Tehuantepec. Regular freight trains are now running between the City of Mexico and Toluca.

A NEW PENNSYLVANIA ROAD.—A charter has been granted to the Gettysburg & Emmittsburg Railroad Company, which is authorized to build a road, six miles long, from a point of connection with the Round Top Railroad, at its terminus at Round Top, Adams county, to a point on the Pennsylvania and Maryland State line. The capital stock is $60,000.

A NEW ILLINOIS ROAD.—The Roodhouse & Scottsville Railroad Company has been organized. Capital $200,000. The projected road is an important branch of the Burlington & Ohio River, which is now being rapidly built from Gillespie to Scottsville. Track-laying is in progress from Gillespie toward Carlinville. This will complete the new Kansas City short line east *via* the Chicago & Alton and the Cincinnati, Cleveland & Columbus and Indianapolis & St. Louis from Roodhouse to Gillespie.

THREE thousand tons of steel rails have been loaded on barges at Pittsburgh ready to go South on the first high water. Two thousand tons go to Anthony Ferry, Yazoo River, to be laid in Sharkey county, and 1,000 tons to New Orleans, for the road between that city and Baton Rouge.

DULUTH & WINNIPEG.—The surveyors on the Duluth and Winnipeg lines are cross-sectioning at a point eighteen miles from Duluth. The road is to extend 300 miles due north from Duluth to the Manitoba boundary line. Graders are at work about eight miles from Duluth. The country is rocky and woody, notwithstanding which the cost is expected to be only $20,000 per mile. Work was begun last winter.

SURVEYING COMMENCED.—A party has commenced the survey of the Chicago, Indiana & Ohio River Railroad. The line will run from Hammond to Terre Haute, Ind.

A NEW ELEVATED ROAD COMPANY.—BOSTON, Nov. 13.—J. V. Meigs has petitioned the Legislature for the incorporation of a company with authority to construct and maintain an elevated railroad in any city or town in which the authorities may grant leave, the capital stock of the company to be $1,000,000.

NEARING THE RIO GRANDE.—A note from San Antonio, Tex., of Nov. 10 says: The Eagle Pass Branch of the Galveston, Houston and San Antonio Railway will reach the Rio Grande tomorrow. Contractors are here making terms for the construction of the work on the Mexican extension of this line.

WORK has been commenced on a street-car line for Monterey, Mexico.

PROJECTED SOUTHERN ROAD.—A new road, called the Louisville & Southern Railway, is projected, to run from Louisville to Danville, O. A part of the line has been surveyed.

CANALS.

SURVEYORS are at work on the Hennepin Canal.

BUILDERS OF A NEW SHIP CANAL.—WILMINGTON, Del., Nov. 13.—Gen. Horace B. Tibbetts, President of the Delaware & Maryland Ship Canal Company (Sassafras route), in company with Gen. Guilelmo Nanne, President of the Central American & Nicaragua Railroad; Col. G. M. Totten, Consulting Engineer of the Panama Canal; M. A. & H. B. Slaven, of the American Dredging Company, and one or two others, representing a syndicate of European capitalists, has been down the State inspecting the proposed route for a ship canal between the Delaware and Chesapeake, and left here for Philadelphia this afternoon. The estimated cost of the canal, which would be about 110 miles long, is $6,000,000. Gen. Tibbetts is reported as saying that they are now ready to go to work, and that the canal will be pushed to completion without asking Government aid.

CANAL TO PULLMAN, ILL.—The Chicago *Times* says: It can be announced that a very important move in the interest of the Calumet region will be made Monday, it being the commencement of work upon the much talked of canal which is to connect the Calumet River at Cummings with the Calumet Lake at Pullman. For some time the project of building a canal at this point has been agitated, and its necessity has been obvious. As it is at present, the Calumet River winds around to the south and west so that it is about five miles from the mouth of the river in South Chicago harbor to where the river enters the Calumet Lake at its southern extremity. A vessel to reach Pullman would then have nearly two miles more to go, as that city is located near the northern extremity of the lake. The canal as projected is to be about half a mile in length from river to lake, is to be 100 ft. wide and 16 ft. deep.

BUILDING.

VENTILATION OF THE GUILDHALL.—Messrs. Boyle, of Holborn Viaduct, have just fitted this ancient chamber with sixteen boxes, technically known as "inlets," which are heated by gas-jets artfully concealed in the wall. These inlets are in direct communication with the outer air, which is thus warmed before reaching the chamber. By an arrangement of pipes within the box the water which is condensed by the atmosphere of the chamber is collected and drawn off. A temperature of 60 degrees to 120 degrees can be obtained with the apparatus. Nine air-pump ventilators are placed upon the roof of the chamber for extracting the vitiated air.—*London Ironmonger.*

TEXAS STATE CAPITOL.—The capitol contractors expect to commence work Dec. 1.

PONTIAC, Ill., is to have a new city-hall.

CAPITOL EXTENSION.—The annual report of Edward Clark, the architect of the United States Capitol, shows that the amount expended for capitol extension during the last fiscal year was $57,000; for lighting the capitol and grounds, $30,000; for care and improvements on the same; $60,000; for extension of the government printing office, $40,000; enlarging the Washington court-house, $117,000.

BRIDGES.

THE NEW BRIDGE of the Chicago & Great Southern road at Attica, Ind., which road runs from the coal fields of Parke County to Chicago, is under full headway, quite a large force of men being at work on it. The work of laying the track from Oxford, Benton County, is going rapidly forward.

MISCELLANEOUS.

THERE are now in the United States fifteen Bessemer steel works, with 37 converters that are capable of producing in the neighborhood of 2,000,000 tons of Bessemer steel annually.

THE purchases of barbed wire on the part of the American farmers, according to the Washburn & Moen Company, the largest makers, amount in 1874 to 10,000 lbs. made and sold; in 1875, to 600,000 lbs.; in 1876, to 2,840,000 lbs.; in 1877, to 12,863,000 lbs.; in 1878, to 26,655,000 lbs.; in 1879, to 50,337,000 lbs.; in 1880, to 80,500,000 lbs.; in 1881, to 120,000,000 lbs.; in 1882, to 160,000,000 lbs. The total of 456,805,000 lbs. represents 414,434 miles of efficient barbed-wire fence three wires high.

THE POTOMAC FLATS.—A Washington dispatch of the 16th states that the bid of P. Sanford Ross, of Jersey City, has been accepted as the lowest responsible bid.